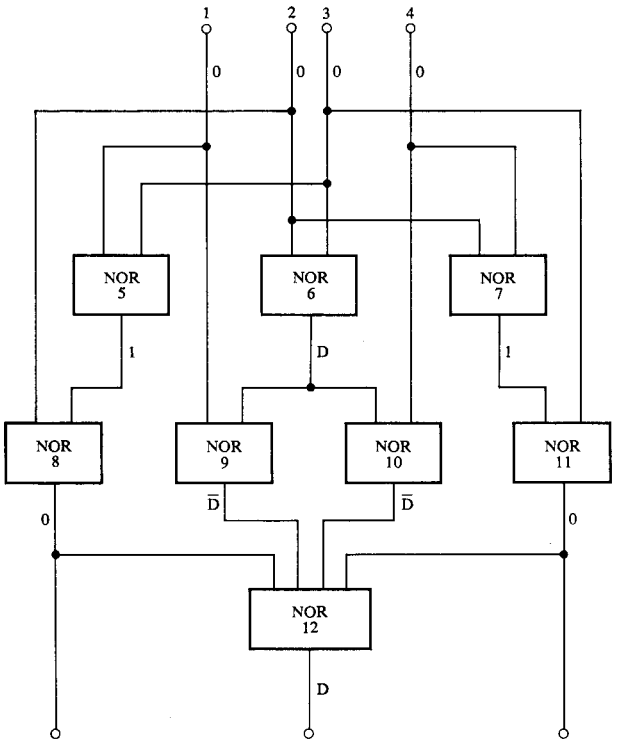
On the Necessity to Examine D-chains in Diagnostic Test Generation—An Example

In a recent paper by Roth,[1] a method called the D-algorithm was developed for generating diagnostic tests for failures in acyclic switching circuits. One of the innovations of his D-algorithm was that it could follow parallel paths, or "chains" of paths, carrying the "failure" signal to the outputs. This allows him to guarantee finding diagnostic tests for failures in circuits with reconverging fan-out, something none of the old "sensitized path" algorithms could do. However, an example demonstrating the need for examining chains was not presented in the paper. To give such an example is the object of this letter.



In the circuit here, assume the failure under consideration is line 6 stuck at 0. Then the signal values shown just beside each line are those which would be generated during the development of a test using Roth's D-algorithm (as usual the D denotes a 1 in the good circuit and a 0 in the failing circuit). The D's (or D̄'s) were propagated first through block 9, then 10, and finally through block 12.

Any sensitive-path procedure would necessarily have sought to propagate the failure signal only through 9 or only through 10 but not through both simultaneously. By symmetry, it is required only to explore one of those two situations. If the failure signal is to proceed from block 6 through blocks 9 and 12 it is necessary that blocks 10 and 11 have outputs equal to 0; hence, primary input 4 and block 7 must have value 1. Clearly, NOR block 7 cannot simultaneously have an input value 1 *and* an output value 1. Thus, although a test exists for the given failure, no sensitive-path algorithm can be capable of generating it.

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Reference

1. J. Paul Roth, "Diagnosis of Automata Failures: A Calculus and a Method," *IBM Journal* 10, 278 (1966).